Space Weather Technical Forecast

Issued on Wednesday, 29 June 2022 at 01:30 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Active electron fluence continuing. Slight chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no significant flares observed. There are currently five sunspot regions on the visible disc. AR3040 in the southwest quadrant remains the largest region and has been magnetically stable. However, in recent hours there appears to be the emergence of a negative polarity spot close to a small positive polarity area in the north of the group. AR3041 (Cao/Beta) has now reached the northwest limb and has become difficult to analyse, due to the foreshortening effect on the viewing angle. AR3042 (Cro/Beta), to the north of AR3040 continues to slowly develop, but remains a small and fairly simple bipolar region, with one of the spots currently displaying a rudimentary penumbra. The two other new regions, AR3043 and AR3034, both in the southeast quadrant appear to be decaying, with AR3043 now an Axx/Alpha group. A new sunspot group may be emerging in the far southeast and will be monitored for any further development.

There are considered to be no new Earth-directed CMEs showing on available imagery. However, a large filament lift off from around N20, just east of the centre disc around 28/2200 UTC will be assessed when further imagery becomes available.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, was largely elevated, varying between 490-560 km/s, suggesting the ongoing influence of a coronal hole high speed stream. Density was mainly average. The Phi angle was predominately negative (towards the Sun). The total Interplanetary Magnetic Field (IMF) was weak and below 6nT, the North-South component, Bz, fluctuating between +/-5nT. The resulting geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) as measured by GOES16 remained at Background levels throughout the period. The High energy electron flux (greater than 2MeV) remained at high levels for much of the last 24 hours, reaching a peak of 4930 pfu at 28/1515 UTC, before becoming Moderate from 28/2205 UTC. The corresponding 24-hour electron fluence remained above the Active threshold (1e8 integrated pfu) throughout, reaching a peak of 2.36e8 integrated pfu at 28/2100 UTC. An observed fluence of 2.3e8 integrated pfu was recorded at 29/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Low or Very Low, with only a slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A very slow CME which left the Sun on the 26th June may arrive at Earth on the 2nd July (Day 4). No other earth-directed CMEs currently feature in the forecast, however, the large filament eruption from around N20 in the eastern hemisphere around 28/2200 UTC will be assessed once more imagery becomes available. Solar winds are forecast to slowly come back to slow-ambient levels over the next two or three days as the influence from CH93 and CH94 wanes. No further significant enhancements are expected over

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the next four days. Geomagnetic activity is currently expected to be mainly Quiet with isolated Unsettled intervals through the period.

Energetic Particles / Solar Radiation: In the absence of any significant sunspot development, the High energy proton flux (greater than 10 MeV) is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to continue at mainly High levels until at least day 2 (30th), thereafter a drop in electron flux to more persistently Moderate or Background levels appears probable. Corresponding electron fluence is expected to remain above the Active (1e8 integrated pfu) fluence level until at least day 2. After this it may lower to Moderate levels, though confidence in the timing of this occurring is medium.

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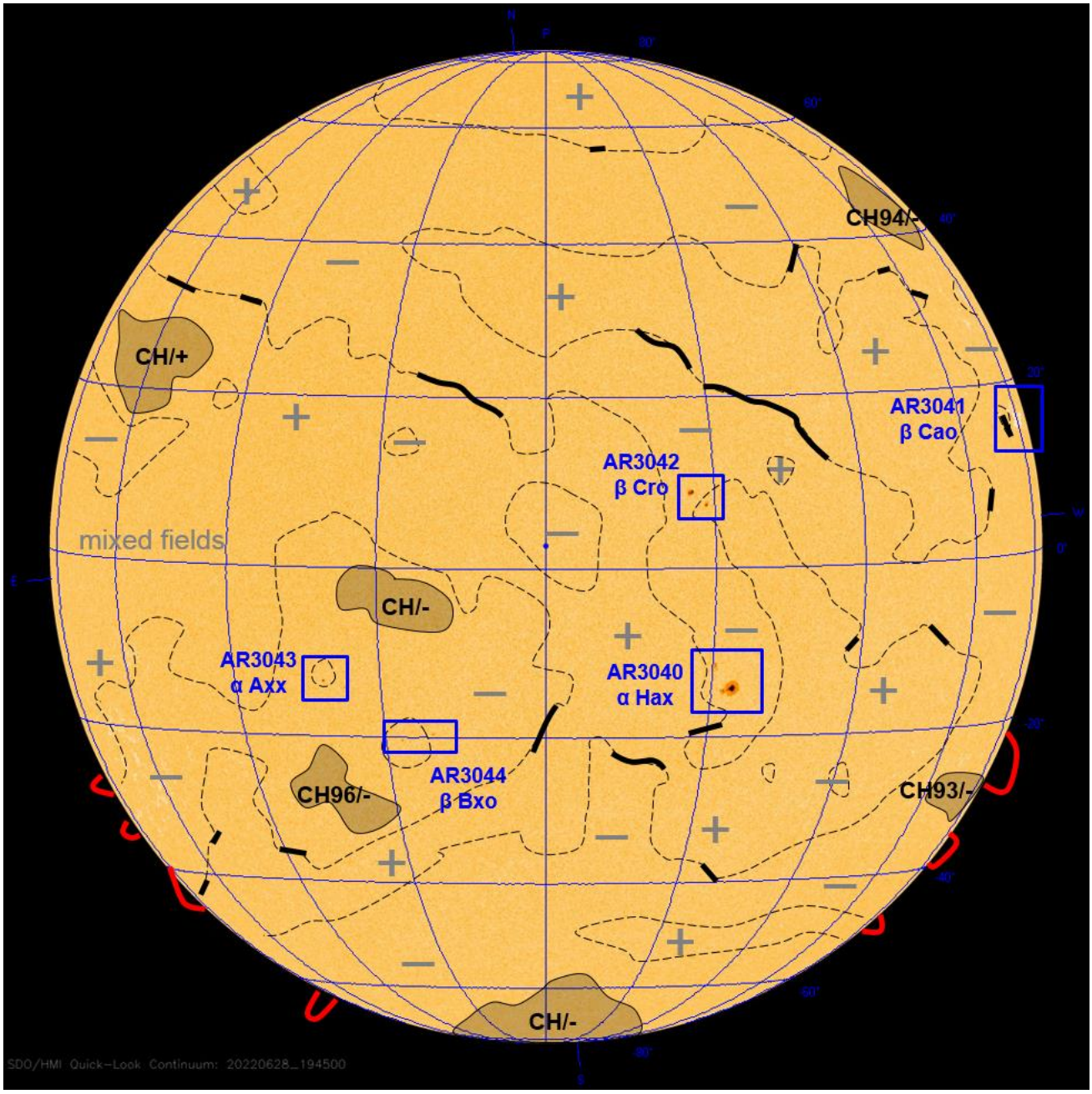
Figure 1. Solar Analysis Valid 28/1945 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

A very slow CME which left the Sun on the 26th may arrive at Earth on the 2nd July (Day 4). No other earth-directed CMEs currently feature in the forecast, however, the large filament eruption from around N20 in the eastern hemisphere around 28/2200 UTC will be assessed once more imagery becomes available.

With Coronal holes 93 and 94 now close to the western limb and no other features visible in the western hemisphere, solar winds should observe a slow decline from elevated speeds and come back towards slow-ambient levels over the next two or three days. The next possible HSS to become geo-effective is currently expected to arrive the 3rd July. Geomagnetic activity is currently expected to be mainly Quiet with isolated Unsettled intervals through the period.

There is a large filament in the northwest quadrant. It is currently stable but will need to be monitored for any potential lift off.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
27/1714	Partial	Filament eruption	Centre disc	242 km/s	02/1200UTC +/-12 hours	Limited shock expected

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Radio Blackouts - X-Ray Flares:

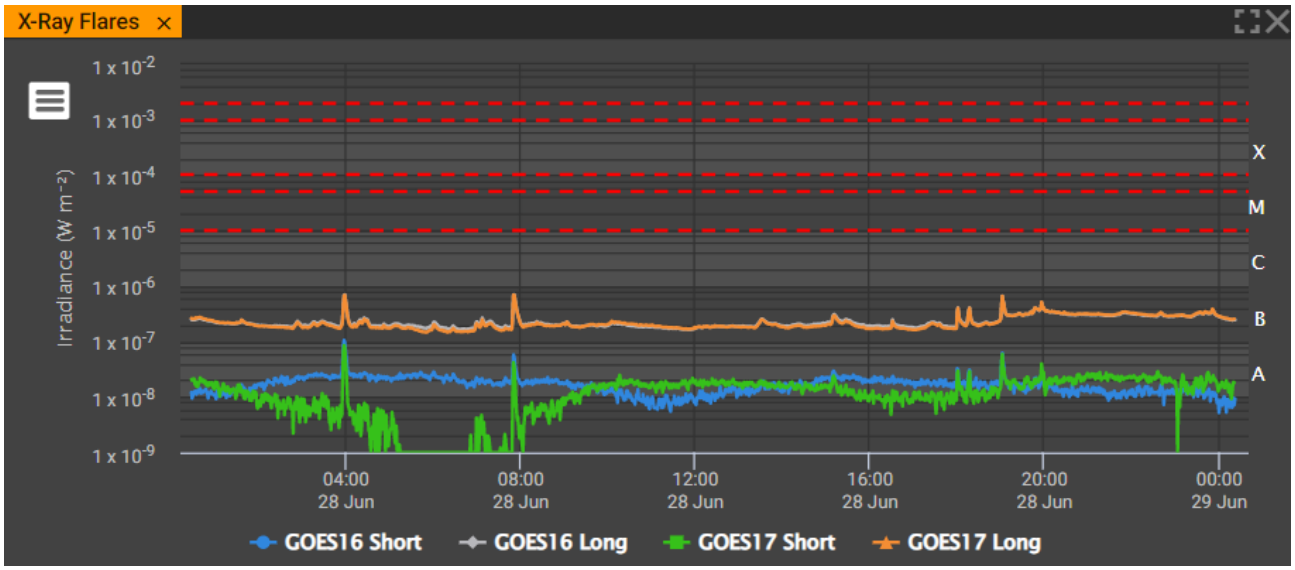
Solar activity has been Very Low over the past 24 hours, with no significant flares observed. There are currently five sunspot regions on the visible disc. AR3040 (Hax/Alpha) in the southwest quadrant remains the largest region. However, in recent hours there appears to be the emergence of a negative polarity spot close to a small positive polarity area in the north of the group. AR3041 (Cao/Beta) has now reached the northwest limb and has become difficult to analyse, due to the foreshortening effect on the viewing angle. AR3042 (Cro/Beta), to the north of AR3040 continues to slowly develop, but remains a small and fairly simple bipolar region with one of the spots displaying rudimentary penumbra. The two other new regions, AR3043 and AR3034, both in the southeast quadrant appear to be decaying, with AR3043 now an Axx/Alpha group and AR3044 a Bxo/Beta group. A new sunspot group may be emerging in the far southeast and will be monitored for any further development.

Activity is expected to remain Low or Very Low, with only a slight chance of isolated M-flares.

A bright flux region is visible on STEREO-EUVI imagery (around N20 E110), perhaps indicating the presence of an active region. This would be expected to rotate onto the Earth-facing disc on day 2 or 3 (30th June or 1st July).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 2. GOES16 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and will most likely remain at this level through the period, in the absence of any significant sunspot development.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux, as observed by GOES-16, remained at mainly High levels during the period, only briefly dropping to Moderate between 28/2205-2315 UTC.

Electron flux levels are expected to continue at mainly High levels until at least day 2 (30th), thereafter a drop in electron flux to more persistently Moderate or Background levels appears probable. A further drop in electron counts could take place with the arrival of the very slow CME on the 2nd (Day 4), though confidence in this is medium and any impacts likely very limited.

Corresponding electron fluence is expected to remain above the Active (1e8 integrated pfu) fluence level until at least day 2. After this it may lower to Moderate levels, though confidence in the timing of this occurring is medium. Active levels of fluence were observed around 24 hours later than standard 27-day persistence had indicated, though this and the REFM forecast indicate fluence levels remaining above the Active threshold well into day 2 and perhaps into day 3. This gives added confidence to the current forecast.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	90	50	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	5	1	1	1

Figure 3: GOES16 Electron Flux (top) and MOSWOC REFM forecast (below)

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